



Chapter 16. Predicting Weather by Connecting the Basic Cloud Types With Information Collected from the Weather Station: A Guided or Open-Inquiry Activity

Important considerations in predicting the weather are collected weather data, the current wind direction, and the observable cloud types. Over the past several pages, an examination and involvement with using instruments to collect and understand important weather data have taken place. The important factor of winds has been discussed as well. The observable cloud type is another critical factor.

IMPORTANT NOTE: You should make it a habit to observe the sky at several times each day to get familiar with important changes in sky conditions. Often, very dramatic changes in sky color are observable—especially in the early morning and late evening. These observations help you to design activities to learn even more about the weather. As a meteorologist suggests, “look up.”

The early weather forecasters, including sailors and farmers, paid close attention to the clouds to understand more about approaching weather. Rising air masses produce various types of clouds as the air mass reaches a temperature where the air is cooled below the dew point (like water droplets forming on the outside of glass on a warm summer day). Because of the cloud condensation nuclei (CCN) as shown in the “cloud in a bottle” chapter, the moisture released from the air condenses around these CCN particles and forms a cloud of liquid or solid droplets.

Although the study of clouds can constitute several days of study, a discussion of the very basic cloud types will take place here and will provide sufficient background to enable some amateur weather predicting. There are three major cloud types: stratus, cumulus and cirrus. All other cloud types are a combination or a variation of these three types. These three types are discussed in more detail below.

Stratus clouds (Figure 16-1) are one of the lowest levels of clouds. There are two variations of stratus clouds called *nimbostratus* and *altostratus*. The terms *nimbo* and *nimbus* mean “rain.” *Nimbostratus* clouds do bring heavy rains or snow. *Altostratus* are stratus clouds at higher elevations.



Figure 16-1. Stratus clouds.

Cumulus clouds (Figure 16-2) form throughout the troposphere. *Cumulus* means “piled” or “heaped.” This type of cloud forms when large masses of air rise and cool. They have a flat base that depicts the altitude level at which condensation began, and the



Figure 16-2. Cumulus clouds.



Figure 16-2. Stratocumulus clouds.

height of the cloud indicates the level that the cooling air rose. The lowest level clouds are known as *stratocumulus* (Figure 16-3). These thick cumulus clouds with billowy tops are usually associated with fair weather. Often during the summer on hot humid days, large thick clouds called *cumulonimbus* or thunderclouds form. This type of cloud often produces rain, lightning and thunder.

Cirrus clouds (Figure 16-3), the highest level of clouds, form in the upper regions of the troposphere. *Cirro* and *cirrus* mean “curly.” They look like horse-tails. Because these clouds form at such high altitudes at very low temperatures, they are thin clouds composed mainly of ice crystals that allow sunlight and moonlight to easily pass through. *Cirrocumulus* clouds form at very high altitudes, although very rarely, and are composed entirely of ice crystals and appear just before a snowfall or rainfall. *Cirrostratus*



Figure 16-3. Cirrus clouds.

clouds, rare in forming, will often produce a large halo around the sun or moon as the light from these bodies pass through these ice crystal clouds. Recall the old adage, “A halo around the sun or moon indicates the coming of precipitation.”

Challenge

If you have been collecting and recording weather data over the last several days, you should be very familiar with the process. You should now carefully record data concentrating on one day. Observe the prevailing wind direction (pay close attention to the wind vane) and make your best prediction of what the weather will most likely be for the following day. If you have the opportunity to do so, continue this process of predicting for several days and make a record of how often you make a correct prediction. As an interesting comparison, clip the weather pages from your local newspaper that correspond to the same days of your collected data and compare the newspaper predictions with your predictions. After this experience, you might come to appreciate the difficult job of meteorologists. As you prepare for this challenge, keep the following in mind:

- Has the barometer been rising or falling?
- What is the relative humidity?
- What is the observable cloud type?
- Has the wind been blowing from the same direction?
- Has the temperature (in general) been rising or falling?
- Has there been any precipitation?
- Do any of the “old adage” statements give additional clues?

The following suggestions are a mixture of scientific information provided by the weather instruments and some of the old adages regarding weather predicting. Perhaps the old adage can be further understood, as to its origin, by doing some comparisons with the scientific data. You might want to review some of the information relating to the weather instruments such as:

- What are indications of a falling or rising barometer?
- What do cloud types suggest about tomorrow's weather?
- Is the air relatively dry or moist (relative humidity)?
- Has the sky been red at night or in the morning?
- Have the leaves on trees been lifted up by a breeze?
- What is the dew point temperature?
- Has there been a halo around either the sun or moon?
- Has anyone (especially older people) complained of aching joints?



It should be made clear that the purpose for mixing the scientific data with some of the old adages is to illustrate that a scientific approach to understanding the world helps to expose a lack of scientific basis for some of the myths or to illustrate some type of scientific connection to these myths. For example, it would be an appropriate educational experience and perhaps add interest for the learner to explore how often a “red sky at night” correlates with a change from fair to stormy weather.

Background for the Teacher

This activity brings closure to the study provided by the various activities and should help the learner to connect the previous experiences more effectively.



Learning about key weather factors by constructing and using the instruments to collect weather data has practical application. Understanding the nature of prevailing winds should help the learner understand that local weather changes often approach from similar directions. Observing or “reading” the sky and connecting these observations with what the weather instruments data show, should provide an interesting and real challenge for all learners. It is recommended that sufficient time be devoted to this activity to discuss and explore the many opportunities for a valid and practical study of a phase of science. This activity requires that learners use collected data, make further current observations of the sky, and reason how these need to be analyzed to carry out their task.

This activity probably falls into structured inquiry because the question to be resolved has been set for them. Their challenge is to “predict tomorrow's weather” and the procedure has been somewhat delineated for them. However, there is some guided inquiry to the procedure because the learner has some latitude to make his/her own choices about how to proceed. It is a most challenging task because they have to infer certain relationships and connect certain parameters in order to come to a resolution to the problem.

Because of the variety of weather conditions on the day the activity starts, it is not possible to give a specific Examining Results section here; therefore, a hypothetical example will be given instead.

Data collected for September 2-3:

The temperature has been rather steady throughout the day at about 79 °F or 26 °C.

The barometer has fallen from 29.4 millibars on September 2 to 29.1 millibars September 3.

High cirrus clouds were observed late in the day on September 2.

The anemometer has been turning between 8 to 12 revolutions per ten seconds.

The wind vane, while shifting positions, has pointed mainly towards the southwest.

The relative humidity is about 85%.

The dew point is 74 °F or 24 °C.

Nimbostratus clouds begin to appear late on September 3.

There was a red sky on the morning of September 3.

Based upon the above data, what would you predict the weather to be on September 4?

The learner might need to review some of the previous activities to recall what factors, such as a falling barometer, dew point temperature, relative humidity and so forth, tend to reveal information about approaching weather.

For example:

A declining barometer pressure indicates an approach of a low-pressure system, which is often associated with stormy weather.

Both relative humidity and dew point indicate a rather saturated air mass.

It will be necessary to read the chart for relative wind speeds, but it indicates a slight breeze of 3 to 4 miles per hour.

The wind vane indicates a southwest wind, which is the prevailing wind direction for most of the United States, and many storms come from this direction.

Cirrus clouds sometimes indicate the approach of a stormy weather system and the nimbostratus clouds are often associated with some type of precipitation.

Prediction for the weather on September 4:

Based upon the hypothetical information given above and the current air temperature, the most logical prediction would be for a stormy weather system with rain for the following day. To add levity to the seriousness of weather prediction, even the old adage, “Red skies in the morning sailors heed warning” bodes in favor of approaching stormy weather.



Selected References on Science Education

American Association for the Advancement of Science. *Science for All Americans*. Oxford University Press, New York, 1989.

American Association for the Advancement of Science. *Benchmarks for Science Literacy*. Oxford University Press, New York, 1993.

Anderson, R. A. "Inquiry in Everyday World of Schools." *Focus*, 6(2), 16-17, 1999.

Audet, R. H., and L. K. Jordan, L. K. Standards in the Classroom: An Implementation Guide for Teachers of Science and Mathematics. Corwin. Thousand Oaks, CA, 2003.

Baker, T.R. *Two Suns and a Green Sky*. TAB Books (McGraw-Hill), USA, 1994.

Barman, C. R. "How Do You Define Inquiry?" *Science and Children*, 39(10), 8-9, 2002.

DeMillo, R. *How Weather Works*. Ziff-Davis Press, Emeryville, CA, 1994.

Krulik, S. and J. Rudnick. *Reasoning and Problem Solving: A Handbook for Elementary School Teachers*. Allyn and Bacon, Boston, MA, 1993.

Lawson, Anton E. *Science Teaching and the Development of Thinking*. Wadsworth Publishing Company, Inc., Belmont, CA, 1995.

Lazarowitz, R. and P. Tamir. "Research on Using Laboratory Instruction in Science," *Handbook of Research on Science Teaching and Learning*, D. L. Gabel (ed.), pp. 94-128. Macmillan, New York, 1994.

Llewellyn, D. *Inquiry Within: Implementing Inquiry-based Science*. Corwin, Thousand Oaks, CA, 2002.

National Research Council. *Inquiry and the National Education Standards*. National Academy Press, Washington, DC, 2000.

National Research Council. *Inquiry and the National Education Standards: A Guide for Teaching and Learning*. National Academy Press, Washington, DC, 2000.

Padilla, Michael J., et al. *Science Explorer*. Prentice Hall, Upper Saddle River, NJ, 2002.

Ramsey, William L., et al. *Modern Earth Science*. Holt, Rinehart and Winston, New York, 2002.

Schwab, J. J. *Biology Teachers' Handbook*. Wiley, New York, 1963.

Schwab, J. J. "The Practical: A Language for Curriculum," *School Review*, 78, 1-23, 1969.

Schwab, J. J., and P. F. Brandwein. *The Teaching of Science*. Harvard University Press, Cambridge, MA, 1962.

Welch, W. W., L. E. Klopfer, and G. E. Aikenhead. "The Role of Inquiry in Science: An Analysis and Recommendations," *Science Education*, 65 (1), 33-50, 1981.

Williams, Jack. *The Weather Book: An Easy to Understand Guide to the USA's Weather* (Second Edition). Vintage Books, New York, 1997.
